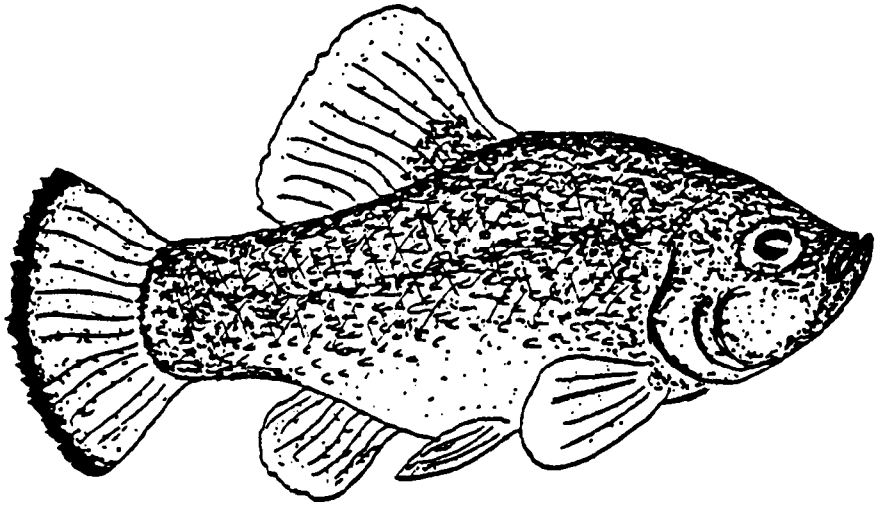
LEON SPRINGS PUPFISH

RECOVERY PLAN



U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

1985

LEON SPRINGS PUPFISH (Cyprinodon bovinus) RECOVERY PLAN

Prepared by

The Rio Grande Fishes Recovery Team

Approved: _____
Regional Director, Region 2
U.S. Fish & Wildlife Service

Date: 8/14/85

SUMMARY

1. GOAL: To improve the status of the Leon Springs pupfish to the point that survival is secured and viable populations of all morphotypes are maintained in the wild. While it may be possible to downlist the species, it may not be possible to delist the species due to extreme limited habitat.

2. RECOVERY CRITERIA: The criteria for downlisting of the Leon Springs pupfish to threatened status is effective maintenance and management of the species as outlined in the recovery plan.

3. RECOVERY ACTIONS : Steps to reach recovery include maintaining and enhancing existing Leon Springs pupfish populations and habitats, preventing introduction of exotic fishes, maintaining genetic reserves of Leon Springs pupfish, and enforcing State and Federal laws protecting the species.

DISCLAIMER

This is the completed Leon Springs Pupfish Recovery Plan. It has been approved by the U.S. Fish and Wildlife Service. It does not necessarily represent official positions or approvals of cooperating agencies (and it does not necessarily represent the views of all recovery tew members/ individuals), who played the key role in preparing the plan. This plan is subject to modification as dictated by new findings and changes in species status and completion of tasks described in the plan. Goals and objectives will be attained and funds will be expended contingent upon appropriations , priorities, and other budgetary constraints.

ACKNOWLEDGEMENTS

The Leon Springs Pupfish Recovery Plan, dated , was prepared by the U.S. Fish and Wildlife Service in cooperation with the Rio Grande Fishes Recovery Team composed of the following individuals:

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PREFACE

The Leon Springs Pupfish Recovery Plan was developed by the Rio Grande Fishes Recovery Team, an independent group of biologists sponsored by the Albuquerque Regional Director of the U.S. Fish and Wildlife Service.

The recovery plan is based upon the belief that State and Federal conservation agencies and knowledgeable, interested individuals should endeavor to preserve the Leon Springs pupfish and its habitat and to restore them, as much as possible, to their historic status. The objective of the plan is to make this belief a reality.

The recovery team has used the best information available to them and their collective knowledge and experience in producing this recovery plan. It is hoped the plan will be utilized by all agencies, institutions, and individuals concerned with The Leon Springs pupfish to coordinate conservation activities. Periodically, and as the plan is implemented, revisions will be necessary. Revisions will be the responsibility of the Regional Director and implementation is the task of the managing agencies, especially the Texas Parks and Wildlife Department and the U.S. Fish and Wildlife Service.

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PART I

INTRODUCTION

The Leon Springs pupfish, Cyprinodon bovinus Baird and Girard, was listed as endangered in 1980 (Federal Register, Vol. 45:54678). The species is also protected as endangered under Chapter 68 of the Texas Parks and Wildlife Code, listed as a threatened species by the American Fisheries Society, and as endangered by the Texas Organization for Endangered Species and the International Union for Conservation of Nature and Natural Resources.

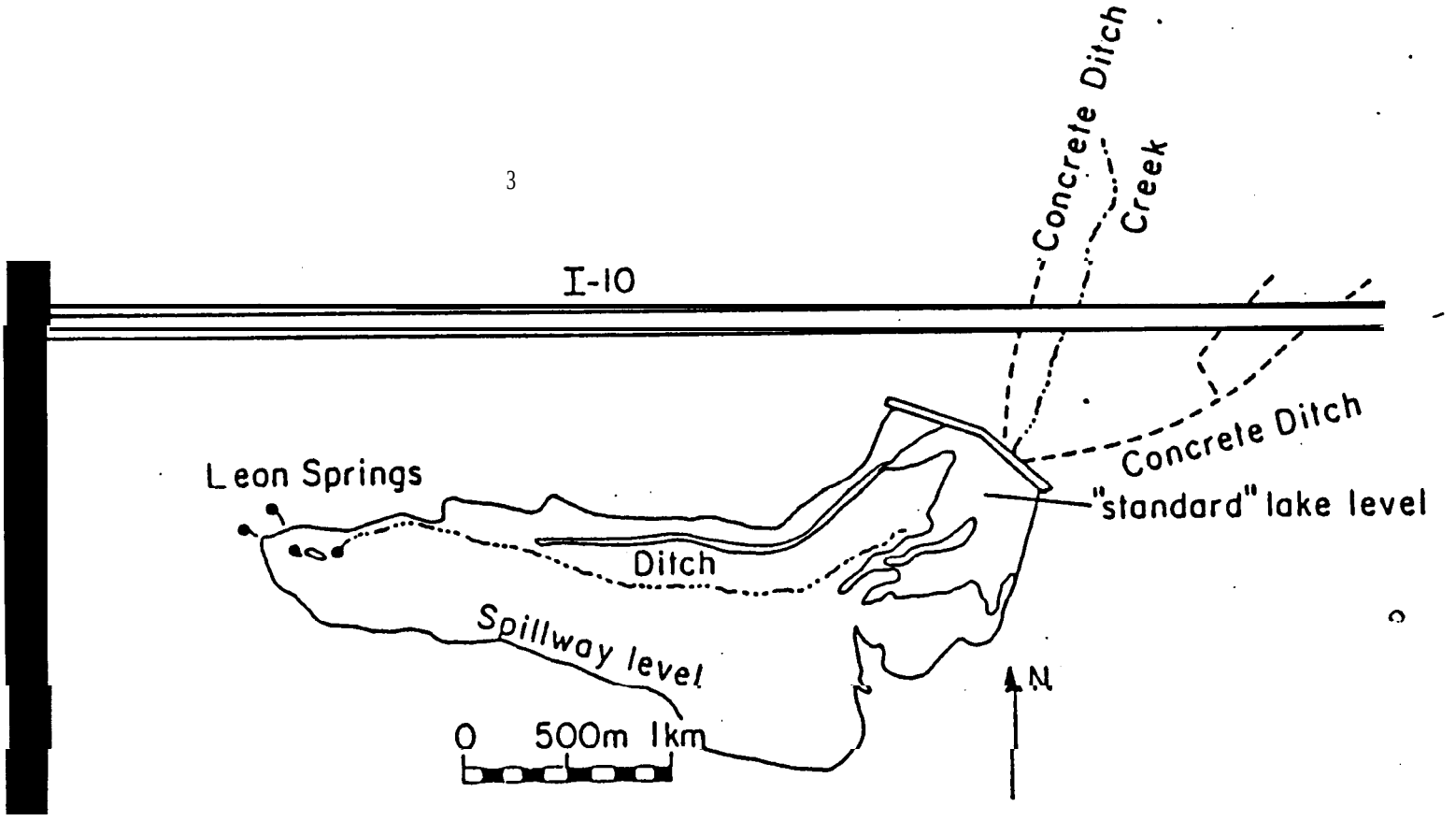
Description and Relationships

Cyprinodon bovinus is a small, robust pupfish up to 50 mm in standard length that has a little wider head and body than most Cyprinodon. The species is most similar to C. tularosa (a species restricted to the isolated Tularosa Basin, New Mexico) which differs in a variety of scale counts and body measurements (Miller and Echelle 1975). Cyprindon bovinus is distinct from the three other Cyprinodon that occupy the Pecos River drainage. The most conspicuous distinguishing features are: (1) lack of the pronounced vertical bars present on the trunk of C. variegatus, a species introduced from coastal waters; (2) lack of the peculiar speckled pattern of C. elegans males (Echelle and Hubbs 1978); and (3) differing from C. pecosensis in having a fully scaled abdomen and, in breeding males, yellow pigment on the dorsal and caudal fins (Echelle and Echelle 1978). An electrophoretic survey confirmed that C. bovinus is genetically distinct from these three species, as well as others (Williams 1981).

Historical Distribution

Cyprinodon bovinus was described on the basis of 16 specimens collected from "Leon's Springs, Texas" in 1851 by members of the U.S. and Mexican Boundary Survey (Baird and Girard 1853, Girard 1859). The type locality presumably is Leon Springs, a spring system that once flowed in the Leon Creek drainage about 10 km west of Fort Stockton, Pecos County, Texas (Fig. 1) (Echelle and Miller 1974). Subsequent attempts to collect the species were unsuccessful and it was believed extinct (Hubbs 1957, Miller 1961). However, in 1965 the species was taken by W. L. Minckley and W. E. Barber from "Willbank Spring" (= Diamond Y Spring) which is in the Leon Creek drainage, approximately 15 airline km downstream (NE) from Leon Springs (Minckley and Arnold 1969).

Fig. 1 Map of Lake Leon area. The extent of Lake Leon varies but seldom since 1950 has it extended to cover the dry Leon Springs. Flow down the creek is even less frequent and the dry bed has long been obscured.



Present Distribution and Abundance

The area presently occupied by *C. bovinus* can be separated into four parts: (1) Diamond Y Spring and its run, (2) a series of interrupted pools (connected during high water) in a section of Leon Creek that begins approximately 2.5 km upstream from the Diamond Y Spring-Leon Creek confluence, (3) a section of Leon Creek about 2 km long ("upstream watercourse" herein) which receives flow from a marsh fed by Diamond Y Spring, and (4) a 3.5 km "downstream watercourse" of Leon Creek (Fig. 2).

The downstream watercourse is, except during storms, separated from the upstream watercourse by approximately 1.5 km of dry creekbed. The watercourse terminates in a small playa/pond that often is dry.

The species occurs abundantly (4.17 individuals/m^2) in marshes, channels, and pools throughout the four areas just described (Kennedy 1977, Echelle and Echelle 1980). Kennedy (1977) suggested that in cold weather the populations in these pools experience a marked die-off but Hubbs et al. (1978) disagreed.

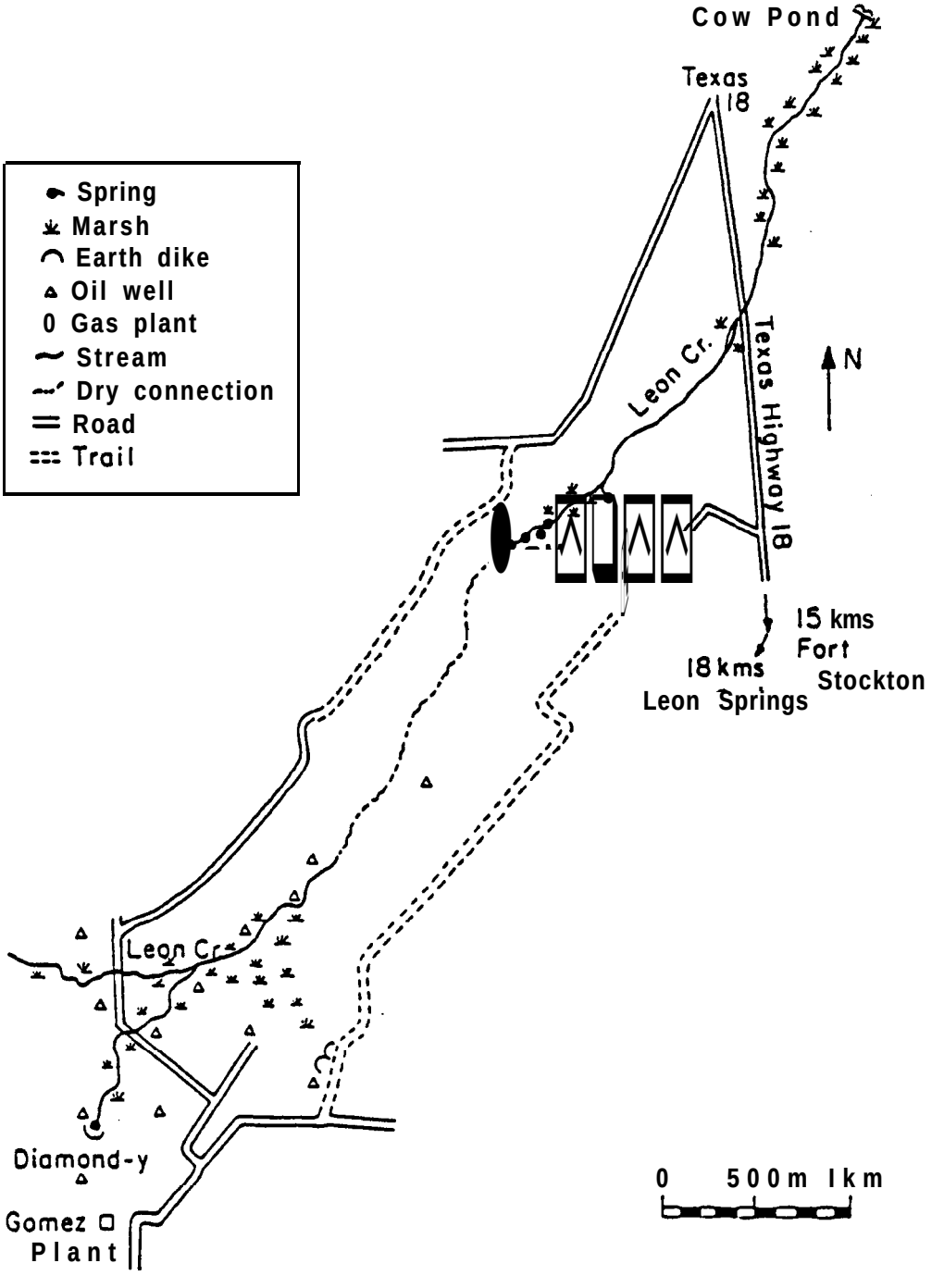
Reasons for Decline

Loss of habitat in the area of the type locality, Leon Springs, was a major factor contributing to decline of *C. bovinus*. The fish was extirpated from the Leon Springs locality prior to 1938 (Hubbs 1980). The Leon Springs locality was inundated by Lake Leon, an irrigation and fishing impoundment constructed in 1918. In 1938, this impoundment had an abundant population of carp (*Cyprinus carpio*). No early records are available on population density of pupfish in Leon Springs; however, the density must have been substantial as the 16 individuals taken originally (type series) were a relatively large sample for the Boundary Survey collections. Leon Springs once produced a flow of about 600 liters/sec (20 cfs), but due to overdraft of the groundwater and lowering of the water table, the springs produced no measurable flow by 1958 (Brune 1981, Scudday 1978). A century ago, waterflow and associated pools, marshes, and channels probably extended from Leon Springs to the area presently occupied by *C. bovinus*, at least during wet periods. The stream segment once occupied by *C. bovinus* must have been several times longer than at present, because much more water would have flowed in the watercourse.

Ecology

The general biology of *C. bovinus* was described by Kennedy (1977). Like most other pupfishes, it is an omnivore that feeds primarily on the bottom substrate and ingests large amounts of inorganic sediments,

Figure 2. Habitat of Cyprinodon bovinus in Diamond Y Spring and Leon Creek near Fort Stockton, Texas (from Hubbs 1980).



detritus, algae, and small animals. Reproduction occurs during most months of the year. Spawning occurs on the bottom substrate in territories agressively defended by individual males.

The critical ndnimum temperature ranges fran -0.2 C to 2.5 C., depending on the time of day (lower in a.m.) and season (lower in winter). Critical maximum temperature shows a similar pattern of variation and ranges from 36.8 C to 41.5 C (Kennedy 1977). Successful development through the hatching stage occurs at 17.5 to 37.75 C in thermally constant laboratory chambers (Williams 1974). The wide thermal ranges for vital functions are typical for pupflshes. Egg production and viability, however, may have rather narrow thermal limits (Gerking 1981).

Waters presently occupied by C. bovinus are relatively saline, with conductivities as high as 18,000 microhms/cm (Echelle and Echelle 1980), i.e., in excess of 15 ppt total dissolved solids. Salinities in the historic habitat at Leon Springs were 1.4 ppt (Brune 1981). Thus, the species is tolerant of a wide range of salinities.

The extended breeding season, wide salinity and temperature tolerances, and broad food habits of C. bovinus suggest that (e.g., Martin 1972, Echelle et al. 1972), it is a generalist that does best in simple communities with few competing species.

Hubbs (1980) reviewed the fishes known from the Leon Creek area. Fishes consistently found with C. bovinus in Leon Creek are Cyprinus carpio (Diamond Y Spring 'headpool'), Fundulus zebrinus, Lucania parva, Gambusia affinis, G. nobilis, G. affinis x G. nobilis hybrids, G. geiseri (Diamond Y Spring primarily), and Lepomis cyanellus. Species taken sporadically are Notropis lutrensis and Micropterus salmoides. Although not collected fran the drainage in recent years, Astyanax mexicanus was taken from Leon Springs In 1938 (Carl L. Hubbs, field notes). Finally , there are hearsay records of Ictalurus punctatus in the headpool of Diamond Y Spring. An introduced pupfish species, Cyprinodon varlegatus, from the Atlantic and Gulf of Mexico coasts, apparently has been eradicated from the area (see below). Gambusia geiseri and Cyprinus carpio, are exotic to the area; the former presumably was introduced from the east side of the Edwards Plateau sometime after 1938 (Hubbs and Springer 1957).

Major Threats

As suggested for C. elegans, another pupfish in isolated springs of the Pecos River Valley-(U.S. Fish and Wildlife Service 1981), there are three major threats to C. bovinus: (1) habitat loss from reduced surface waters, (2) degradation of genetic integrity caused by hybridization with

introduced congeners, and (3) competition with introduced species. In addition, the habitat of the species occurs in an old but active oil/gas field and the dangers of pollution and habitat alteration by oil field activities potentially threaten the species.

1. Habitat loss--The survival of C. bovinus depends on persistence of spring/seep flows. Obviously, if the stream bed is dry no fish will live there. On the other hand, it has been demonstrated that the mere existence of surf ace waters will not ensure survival of the species because it was extirpated from Leon Springs at a time when the Leon Springs/Lake Leon waters were at a maximum. Although the species is capable of achieving large population sizes in thermally unstable pools, these habitats would not persist if the springs were to fail. Furthe rmore, the springs may represent a last refugium should other fishes be introduced into the area. Cyprinodon'bovinus might be. better adapted to life in the spring environments of Leon Creek than would other species. However, some species, e.g., C. pecosensis and C. variegatus, probably are more competitive in thermally unstable situations. Also, with respect to genetic contamination by introduced pupfishes, such springs might provide the appropriate environmental selection gradients to reduce introgression of the C. bovinus genome.

Springs and seeps feeding the area presently occupied by C. bovinus apparently derive their flow from a saline aquifer that has been less affected by pumping of groundwater than have other springs in the vicinity of Leon Creek. A number of freshwater springs (less than or equal to 1 ppt), some very large, have gone dry due to overdraft of groundwater, primarily for irrigation purposes (Brune 1981, Scudday 1978). Presumably, Diamond Y Spring and associated springs have survived because the water is not desirable for most human uses. However, although Brune (1981) suggested that the flow in Diamond Y Spring is dependent on underground flow from Lake Leon, the exact source is unknown and needs investigation.

2. Hybridization--Like other Cyprinodon (Turner and Liu 1977), C. bovinus seems to exhibit little premating reproductive isolation when exposed to other pupf ishes. In 1976, 2 years after C. variegatus was discovered in Leon Creek at the Highway 18 bridge, hybrids between C. bovinus and C. variegatus were very abundant in the lower watercourse. Although two specimens with C. variegatus characteristics were taken near the headpool of Diamond Y Spring, C. variegatus never became established in the upstream watercourse. Preliminary experiments by P. V. Loiselle (pers. comm.) indicated that initial interbreeding in Leon Creek may have been facilitated by the "rare male" ef fect: In mate preference tests, females of C. bovinus actually choose males of a species from west of the Continental Divide, C. macularius, over conspecif ic males. However , similar tests by Garrett (1979) suggested that female C. bovinus are relatively indiscriminate

between males of C. variegatus and C. bovinus. Therefore, C. bovinus clearly has weak premating isolation when exposed to C. variegatus. Presence of the hybrid swarm prompted an intensive effort to remove the introduced C. variegatus genome from the downstream watercourse, an action that apparently was successful (Hubbs 1980). The lesson from the release of C. variegatus into Leon Creek is clear--introduced Cyprinodon pose a very serious threat to the survival and integrity of the C. bovinus genome.

3. Competition--Because C. bovinus apparently has broad ecological needs, almost any co-occurring species of fish, either indigenous or introduced, represents a potential competitive threat. Most desert fishes live in waters with few associated natives; it is these assemblages that are commonly impacted adversely by introduced fishes (Contreras Balderas-1978). However, competition with introduced congeners poses an especially serious problem. Most species of Cyprinodon occur in isolation from other members of the genus (but see Humphries and Miller 1981 for a striking exception). For example, the three native Cyprinodon in the Pecos River are physically isolated from each other and never have been taken together, although in wetter periods (e.g., Pleistocene) there would have been opportunities for contact through the Pecos River. This suggests that two-species assemblages of Cyprinodon are unstable and that when species occur together one is excluded by the other.

Like C. bovinus, the Pecos pupfish, C. pecosensis occurs in saline waters. Therefore C. pecosensis probably-is a more serious threat to C. bovinus than is C. elegans, a species of the Pecos drainage known only from freshwaters. C. variegatus is another species which does well in saline waters, but pure specimens of this introduced species never became abundant in Leon Creek. It appears that hybridization/genetic contamination by C. variegatus was a more serious threat than competition.

Conservation Efforts to Date

United States Fish and Wildlife Service personnel at Dexter National Fish Hatchery, Dexter, New Mexico, are successfully maintaining a large, captive population of C. bovinus.

Northern Natural Gas Company, Exxon Company, and other oil/gas concerns operate in the vicinity of Leon Creek and are cautious to avoid adverse impacts on the area. The Trans-Pecos Soil and Water Conservation District, in cooperation with the Soil Conservation Service, constructed a protective dike around the headpool of Diamond Y Spring to ensure that an oil spill will not reach this habitat. This and other conservation efforts have been greatly facilitated by the concern and hospitality of the landowners, the M. R. Gonzalez family.

Between February 1976 and August 1978, intensive rotenone and seining operations were conducted for the purpose of eradicating the introduced *C. variegatus* genome from Leon Creek downstrew from Diamond Y Spring. The effort was successful (Hubbs 1980).

PART II

RECOVERY

Objective: The ultimate goal of the recovery plan is to improve the status of the Leon Springs pupfish to the point that its survival is secured. Achieving this goal requires implementation of the recovery plan and may result in downlisting the species.

Step-down Outline:

1. Maintain and enhance existing Leon Springs pupfish populations and habitats.

    1.1 Determine biological and ecological requirements.

        1.11 Study canpetition with coexisting species.

        1.12 Study reproduction variables.

        1.13 Investigate predation.

        1.14 Determine surviorshlp.

        1.15 Investigate disease and parasites.

        1.16 Study impacts by exotics.

    1.2 Identify habitat requirements.

        1.21 Determine Leon Springs pupfish abundance at different locations.

        1.22 Investigate impact of other fishes.

        1.23 Obtain physiological data on fishes in Leon Creek.

    1.3 Manage Leon Springs pupfish habitat.

        1.31 Seek and maintain the cooperation of the landowners and government agencies.

        1.32 Provide consultation for oil/gas companies.

        1.33 Provide protection for certain springs, their watersheds and primary distributaries.

        1.34 Establish procedures to prevent introductions of fishes.

            1.341 Waters presently occupied.
            1.342 Lake Leon area.

1.35 Conduct a thorough review of the hydrology of the Leon Creek area.

1.36 Study seasonal distribution of stream flow

1.37 Prepare management plans to include emergency actions in case of spring failure.

1.38 Monitor existing populations and habitats.

2. Maintain genetic reserves of Leon Springs pupfish.

2.1 Continue to culture Leon Springs pupfish at Dexter National Fish Hatchery.

2.2 Reintroduce Leon Springs pupfish into Lake Leon.

3. Disseminate information about Leon Springs pupfish.

3.1 Prepare information pamphlet.

3.2 Produce a motion picture.

4. Enforce State and Federal laws protecting Leon Springs pupfish and its habitats.

4.1 Provide status information, including State protection afforded the species.

4.2 Provide Section 7 consultation and enforce State regulations.

Narra t ive

The ultimate goal of the recovery plan is to improve the status of the Leon Springs pupfish to the point that survival is secured. This goal will be realized when existing occupied habitat is effectively maintained and managed for the species, successful reintroductions are accomplished into the Lake Leon area, efforts are increased to prevent introductions of exotics, and a cooperative relationship exists between landowner, interested public agencies, and other parties. When existing threats have been removed, it may be possible to downlist the species; however, because of extreme limited habitat, it may not be possible to delist the species.

Prime Objective: To improve the status of Leon Springs pupfish to the point that survival is secured and viable populations of all morphotypes are maintained in the wild.

1. Maintain and enhance the existing Leon Springs pupfish populations and habitats.

The only existing natural population of the Leon Springs pupfish inhabits the two disjunct sections of Leon Creek. Management for long-term survival of the species depends upon knowledge of its ecological needs.

1.1 Determine biological and ecological requirements.

1.11 Study competition with coexisting species.

The Leon Springs pupfish eats diverse foods; however, virtually nothing is known of food preferences. The degree of overlap in food preferences with those of coexisting species could adversely impact the Leon Springs pupfish at times when resources are limited.

Competition can involve space as well as food. Pupfish males are known to be territorial and exclude conspecific males. Tests should be conducted to determine if pupfish males exclude other species fran their territories (and vice versa). Fundulus males are larger than pupfish males. Exclusion of Leon Springs pupfish from preferred breeding areas by Fundulus and/or other species should be examined.

1.12 Study Reproduction variables.

Although Leon Springs pupfish reproduce over most of the year, the number of eggs and frequency of egg production are unknown. Information on fecundity would be helpful in predicting

recovery from population minima. This study should include data from stenothermal and eurythermal environments.

1.13 Investigate predation by other species

Few resident piscivores occur in Leon Creek. Green sunfish probably are the principal predators on adult pupfish, but actual consumption figures are unknown. Fish-eating tetrapods have an unknown but probable impact. Field observations and/or laboratory experiments would provide insight into the impact of possible dense populations of piscivores.

1.14 Determine survivorship.

Virtually nothing is known of the survivorship curves for Leon Springs pupf is h. Mortality rates for each life history stage should be determined for stenothermal and eurythermal environnmnts and the information incorporated into a plan for reducing mortali ty.

1.15 Investigate disease and parasites.

No data are available on the diseases and parasites of Leon Springs pupf ish. As the species occupies limited space, an epidemic could seriously impact survival potential. Advance knowledge of the diseases and parasites of Leon Springs pupfish could be of significance in containing an epidemic.

1.16 Study impacts by exotics.

One of the major threats to the survival of Leon Springs pupfish has been the release of non-native fishes into its native habi tat. As it is difficult to identify competitive and/or hybridization interactions with any or all fishes that might be released, this problem might best be approached by efforts to reduce the possibility of any releases (see 1.34).

1.2 Identify habitat requirements.

Valuable baseline data for protection and enhancement of Leon Springs pupfish would be gained from a survey of the physical, chemical, and biotic features in relation to the abundance of Leon Springs pupfish. Preliminary data of this nature (Kennedy 1977) have already contributed to recovery efforts. Kennedy's data should provide a guide for projected studies.

1.21 Determine Leon Springs pupfish abundance at different locations.

The relative numbers of Leon Springs pupfish are known to differ with stream segment more in eurythennal pools than in spring heads. It is not know if the difference in abundance is seasonal (most fish move downstream in summer> or exists at all seasons. A year-round habitat preference study would provide substantial baseline data.

Most of the Leon Springs pupfish habitats have extensive growths of aquatic plants. The relative abundance of Leon Springs pupfish in regions of different concentration of aquatic vegetation is unknown. This insight might permit enhancement of Leon Springs pupfish abundance by a change in abundance of aquatic plants.

1.22 Investigate impact of other fishes.

It is known that pupfish abundance is negatively impacted with abundance of other fishes. The relative abundance of Leon Springs pupfish should be evaluated with regard to the abundance of related species in various habitats and seasons.

1.23 Obtain physiological data on fishes in Leon Creek.

Preliminary data have been obtained on temperature toleration by Leon Springs pupfish, but comparative data are not yet available on most other resident fishes. The preliminary temperature survival data should be confirmed by tests that incorporate various salinites. Similar tests should be performed on other resident fishes to determine relative resistance to environmental extremes. These data might provide insight into survival of Leon Springs pupfish in an extremely adverse environment.

1.3 Manage Leon Springs pupfish habitat.

Leon Springs pupfish is locally abundant in the presently occupied area of Leon Creek. Thus, the present habitat conditions seem appropriate for long-term survival in that location. Effect ive management should include maintenance of existing conditions, increased efforts to prevent introductions of exotic species, and cultivation of the cooperative relationship that exists between landowners, interested public agencies, and other parties, such as the oil and gas concerns operating in the area.

1.31 Seek and maintain the cooperation of the landowners and government agencies.

The M. R. Gonzalez family presently owns the area occupied by Leon Springs pupfish. Steps should be taken to maintain key areas through cooperation of the landowners and government agencies including Texas Parks and Wildlife.

1.32 Provide consultation for oil/gas companies.

The oil and gas concerns operating in the Leon Creek area should be periodically informed of the status of Leon Springs pupf ish and necessary operational precautions. The companies should be canmended for their demonstrated awareness of the potentially disastrous consequences of chemical release, increased siltation, damming, road construction, and removal of water.

1.33 Provide protection for certain springs, their watersheds and primary distributaries.

The landowners effectively bar public access to the area occupied by Leon Springs pupfish. They, and any future landowners, should be encouraged to continue this practice.

The earthen dike around the headpool of Diamond Y Spring should be maintained to protect against inadvertent spillage of oil field effluents into the spring. Other spring outflows should be identified and protected. The entire watershed should be closely observed for any new developments that might alter the presently occupied habitat.

1.34 Establish procedures to prevent introductions of fishes.

Because of the dangers of hybridization and canpetition, introductions of all exotic fishes should be prevented in the Leon Creek watershed.

1.341 Waters presently occupied.

Warning signs should be placed at Diamond Y Spring and other access points to Leon Creek. These signs should explain the potentially disastrous consequences of fish releases and, if possible, give State statutes, and describe a significant fine to be assessed against violators. Leon Creek at the Texas State Highway 18

bridge should be fenced and no trespassing signs should be prominently displayed.

1.342 Lake Leon area.

Lake Leon is a favorite site for local fishermen. The danger exists that "bait-bucket" or other releases of fishes will result in introductions of exotics into Lake Leon, posing a threat to Leon Springs pupfish in downstream areas. Also, such releases might jeopardize attempts to reintroduce Leon Springs pupfish into the Lake Leon area.

A sign similar to that described in 1.341 should be placed on roads giving public access to the lake. Also, local bait suppliers should be made aware of the problem, particularly with reference to exotic species of Cyprinodon.

1.35 Conduct a thorough review of the hydrology of the Leon Creek area.

The aquifer(s) providing flow in the various springs of Leon Creek are poorly understood. knowledge of water sources and usage patterns will allow anticipation of future problems and needs. Once the source(s) of spring flow have been identified, the effects of present and future water use developments should be ascertained. All wells affecting the pertinent aquifer(s) should be documented along with estimates of water removal. This would serve as a point of reference for future assessments.

1.36. Study the seasonal distribution of stream flow.

Availability of water in the area is thought to be relatively consistent but virtually no data are available on seasonal (or other) impacts on stream flow. It is expected that surface evaporation (and perhaps transpiration by plants) would be at a maximum in warm months but the magnitude of that variation is unknown. This study should obtain data on how stream evaporation affects salinity.

1.37 Prepare management plans to include emergency actions in case of spring failure.

The survival of Leon Springs pupfish in its natural habitat

is entirely dependent upon continued flow from springs. Management plans should include the following: (a) the use of wells to supplement, or simulate, springflows; (b) construction of off site refugium canals or pools, (c) monitoring procedures; (d) alternative natural sites for reintroduction of Leon Springs pupfish.

1.38 Monitor existing populations and habitats.

Twice per year existing populations of Leon Springs pupfish should be monitored. The monitoring should be done according to a standardized procedure so that population trends can easily be determined.

2. Maintain genetic reserves of Leon Springs pupfish.

A large viable population of LSP is being maintained at the Dexter National Fish Hatchery in New Mexico. This captive population represents a portion of the total genetic variation and is a valuable genetic resource should a catastrophic loss of the natural population ever occur. The captive-held fish can also be used to provide live or preserved specimens for scientific study and deposition in fish museums.

2.1 Continue to culture Leon Springs pupfish at Dexter National Fish Hatchery.

Culture of Leon Springs pupfish at Dexter should continue indefinitely. The present captive population consists of thousands of individuals that are adequate to meet the purposes given in 2. Individual specimens should be checked annually to verify genetic integrity of the captive stock. To maintain qualitative genetic similarity between captive and natural populations, the former should receive periodic infusions from nature. Identification of all individuals in samples introduced at Dexter should be carefully verified by personnel at Dexter. The introduction schedule should be recommended by the recovery team.

2.2 Reintroduce Leon Springs pupfish into Lake Leon.

Leon Springs pupfish should be reintroduced into Lake Leon to determine the feasibility of establishing an additional population of the species. This reintroduction into formerly occupied habitat should be preceded by an assessment of the environmental conditions in Lake Leon.

3. Disseminate information about Leon Springs pupfish.

A good public information program solicits and encourages support for protection of imperiled species. Information on Leon Springs pupfish

should be disseminated to as varied an audience as possible.

3.1 Prepare information pamphlet.

A pamphlet describing Leon Springs pupfish, its evolution, life history, status and general aspects of recovery efforts should be prepared and distributed.

3.2 Produce a motion picture

A short informational wtion picture describing the LSP and its plight should be produced and made available to the public.

4. Enforce State and Federal laws protecting Leon Springs pupfish and its habitats.

The Leon Springs pupfish is protected by the U.S. Fish and Wildlife Service and Texas Parks and Wildlife Department. Both agencies should be provided information relevant to identification and legal status of the Leon Springs pupfish, its distribution and maintenance of its habitat integrity so that overt, covert or unintentional actions by individuals or projects have no deleterious effect on the species or its habitat.

4.1 Provide status information, including State protection afforded the species.

Enforcement agencies (Federal and State) will be kept informed of the legal status of the Leon Springs pupfish and its habitat according to Federal and State laws. Assistance will be rendered to these agencies so that they may properly identify the species and know where it occurs.

4.2 Provide Section 7 consultation and enforce State regulations.

Those agencies with jurisdiction over project activities which could modify the existing habitat in any way should be kept informed of the status of the Leon Springs pupfish, its distribution and its needs. Section 7 consultation requirements mandate that Federal project specifications preculde any adverse effect on listed species. Protection of the species is a joint responsibility of the U.S. Fish and Wildlife Service and the State of Texas.

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PART III

IMPLEMENTATION SCHEDULE

Definition of Priorities

Priority 1 - Those actions that are absolutely essential to prevent the extinction of the species in the foreseeable future.

Priority 2 - Those actions necessary to maintain the species' current population status.

Priority 3 - All other actions necessary to provide for full recovery of the species.

General Categories for Implementation Schedules

Information Gathering - I or R (research)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonanic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contaminant
13. Reintroduction
14. Other information

Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Disease control
7. Other management

Acquisition - A

1. Lease
2. Easement
3. Management agreement
4. Exchange
5. Withdrawal
6. Fee title
7. Other

Other - 0

1. Information and education
2. Law enforcement
3. Regulations
4. Administration

PART III - IMPLEMENTATION SCHEDULE

GENERAL CATEGORY (1)	PLAN TASK (2)	TASK # (3)	PRIORITY # (4)	TASK DURATION (5)	RESPONSIBLE AGENCY			FISCAL YEAR COSTS (EST)*			COMMENTS (9)
					USFWS		OTHER†				
					REGION (6)	PROGRAM (6a)	(7)	FY 1 (8)	FY 2	FY 3	
I-10	Study competition with coexisting species	1.11	3	3 years	2	SE		1,000	1,000	1,000	Tasks 1.11 thru 1.16 could be best accomplished if funded & conducted as one 3 year study
I-1	Study reproduction variables	1.12	3	3 years	2	SE		1,000	1,000	1,000	
I-9	Investigate predation	1.13	3	3 years	2	SE		1,000	1,000	1,000	
I-14	Determine surviorship	1.14	3	1 year	2	SE		1,000			
I-11	Investigate disease and parasites	1.15	3	1 year	2	SE		1,000			
I-14	Study impacts by exotics	1.16	3	3 years	2	SE		3,000	2,000	2,000	
I-1	Determine abundance at different locations	1.21	3	3 years	2	SE		1,000	1,000	1,000	
19, I10	Investigate impact of other fishes	1.22	3	3 years	2	SE		1,000	1,000	1,000	
I-14	Obtain physiological data	1.23	3	3 years	2	SE		5,000	3,000	3,000	
M-3	Manage habitat	1.31 thru 1.34	2	ongoing	2	SE	TPWD†	1,000	1,000	1,000	

* Costs refer to USFWS expenditures only
† Texas Parks and Wildlife Department

RESPONSES AND REPLIES

A-l Figure 1., Map of Lake Leon area, was added to the Recovery Plan and all other changes as recommended were made.

A-2 Appropriate changes made.

A-3 Text changed as recommended.

A-4 Part III, Implementation Schedule was changed to include Texas Parks and Wildlife Department in Tasks 1.31 through 1.34, 1.37, 1.38, 2.2, 3.1, 3.2, 4.1, and 4.2.

B-l The U.S. Fish and Wildlife Service thanks the Soil Conservation Service for their offer of assistance in protecting the Leon Springs pupfish and its habitat.

We hope the comments will be helpful in completing the plan. However, we feel that the suggestions discussed here must be incorporated before the plan is approved. If you feel that any of the comments do not warrant revision of the draft, please submit your explanation in writing for our consideration before the plan is signed.

Roman H. Koenings

Roman H. Koenings

Attachment

United States Department of Agriculture

Soil Conservation Service

26
101 South Main
Temple, TX
76501-7682

End Sp. R-2
JOHNSON
Burton 13
Anderson
Lewis
McDonald
Stafford
Stout
PADILLA
Harp
Hagg
SANCHEZ
FILE

March 20, 1985

Mr. Jerry Burton
Endangered Species Office
U. S. Fish and Wildlife Service
P. 0. Box 1306
Albuquerque, NM 87103

Dear Mr. Burton:

Our staff has reviewed the draft recovery plan for the Leon Springs **pupfish,** Cyprinodon bovinus.

B-1 On pages 13-15 several actions are recommended for managing the pupfish's habitat. Included are (1) conduct review of the hydrology of Leon Creek, (2) study seasonal distribution of stream flow, and (3) disseminate information about Leon Springs **pupfish.** We are prepared to cooperate In these efforts.

If your agency feels the Soil Conservation Service can assist in any way to protect the Leon Springs **pupfish** and its habitat, please ask.

Sincerely,

Dale Fairchild

FOR BILLY C. GRIFFIN
State Conservationist

FWS REG 2
RECEIVED
MAR 25 '85
SE